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**CONTRIBUTIONS FROM THE BERMUDA BIOLOGICAL STATION
FOR RESEARCH. No. 138.**

**THE ECHINODERMS OF THE CHALLENGER BANK,
BERMUDA.**

BY HUBERT LYMAN CLARK.

WITH ONE PLATE.

(Continued from page 3 of cover.)

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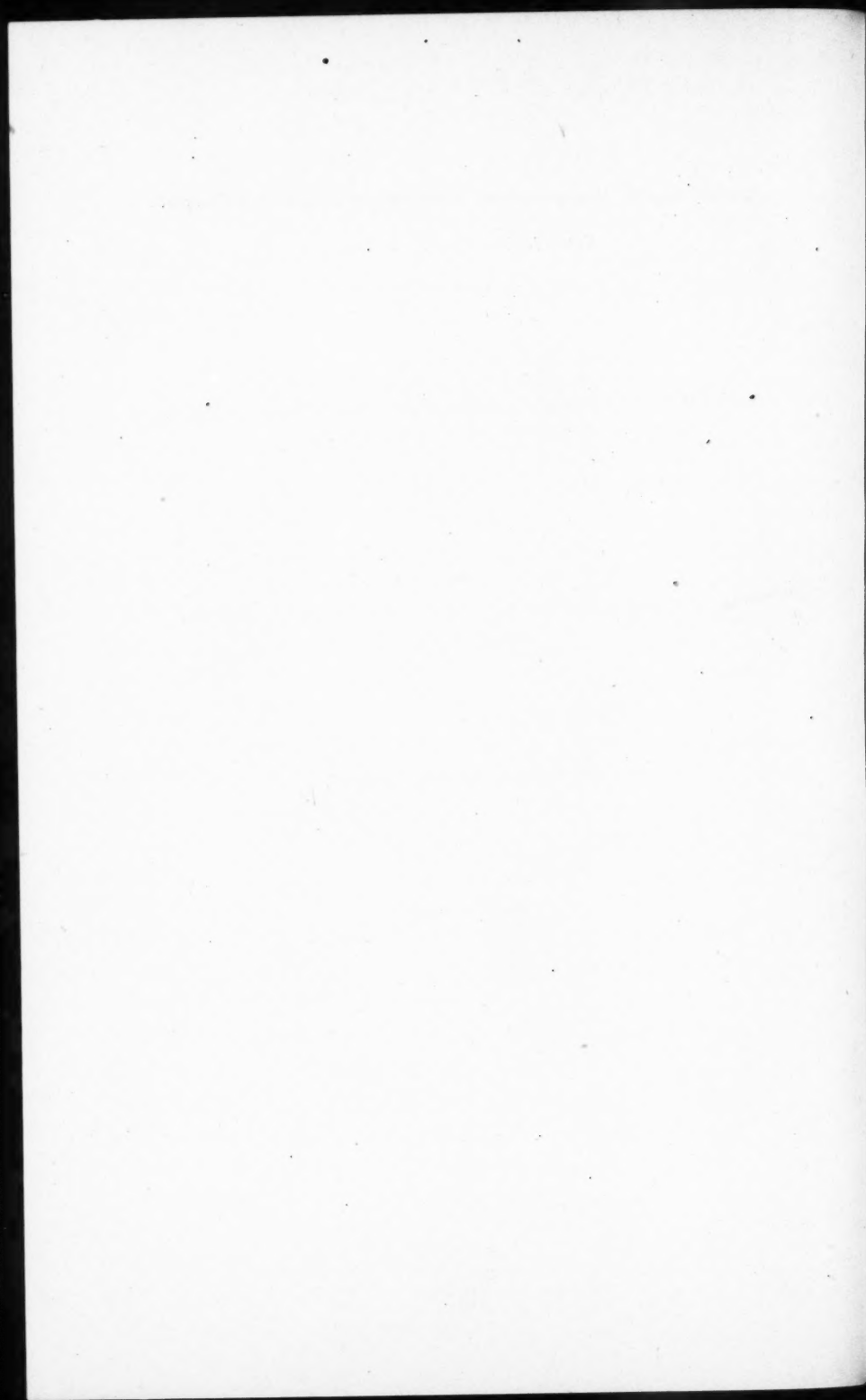
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Presented by E. L. Mark.

Received April 8, 1922.

WHEN H. M. S. CHALLENGER visited Bermuda in 1873, one day (April 23) was spent in "sounding out" the "bank" lying a few miles southwest of the Bermuda bank itself, and as a result this shoal area, some seven miles long and six miles wide, with a minimum depth of 24 fms. has since been known as the Challenger Bank. In August, 1903, a party from the Bermuda Biological Station, under the direction of Professor E. L. Mark and Professor C. L. Bristol, made an excursion to the Bank and did some dredging there.¹ One of the party, Dr. H. B. Bigelow, has published (1905, Proc. Amer. Acad. 40, pp. 586-591) a very interesting account of the physical characteristics of the Bank, and of the peculiar nodules with which it is covered. So far as I can learn, no other scientists have done any dredging on the Challenger Bank and our knowledge of its fauna must thus be based on the material obtained by these parties in 1873 and 1903. The CHALLENGER took but four species of echinoderms, one sea-star (*Chaetaster nodosus*, recorded in the CHALLENGER Reports as *Ch. longipes*) and three brittle-stars (*Ophiomyxa flaccida*, *Ophiothrix angulata*, *Ophiothrix suensonii*). The party from the Biological Station did much better, as they dredged a dozen species. This collection has, through the kindness of Dr. Mark, recently come into the possession of the Museum of Comparative Zoölogy and as it proves to be of unusual interest, the present report has been prepared.

Of the four species taken by the CHALLENGER, the party from the Bermuda Biological Station took all except *Ophiomyxa flaccida*, a

¹ This expedition was made possible by the invitation of the late Captain William E. Meyer, ship owner, of "Glückauf", St. Georges, Bermuda, who very generously fitted out his ocean-going tug GLADISPEN for the occasion, and with her crew personally took the whole membership of the Biological Station, thirty-seven in number, and a few others for a three days' trip to the Challenger Bank. The expedition left St. Georges on July 31st, 1903, and returned on August 2nd. E. L. Mark.

well-known West Indian species common at Bermuda. The other species taken by the Station party were four sea-stars, three brittle-stars and two sea-urchins, and of these nine, one represents a species hitherto undescribed, and three others are not known from Bermuda. As the sea-star *Chaetaster* is also unknown from Bermuda itself, it appears as though nearly half the echinoderms found on the Challenger Bank have not made their way across the three or four miles of deep water that separate them from Bermuda.

All the Echinoderms at present known from the Challenger Bank are referred to below but there is every reason to believe that the list would be greatly augmented by more thorough exploration.

ASTEROIDEA: SEA-STARS.

Chaetaster nodosus.

Perrier, 1875. Arch. Zool. Exp., 5, p. 146 (330 of reprint).
Verrill, 1915. Bull. Univ. Iowa, n. s. no. 92, p. 116; pl. VIII.

The unique holotype of this species was recorded as from "Guadeloupe. M. Duchassaing, 1870," but no specimens were taken by either the BLAKE in her extensive dredgings in the West Indies, 1877-79, or by the ALBATROSS in 1884-87. The expedition from the University of Iowa took two specimens in rather deep water (140-200 fms.) off Havana, Cuba, which in size and appearance were very similar to the holotype. One of these was described and well figured by Verrill, *l. c.* The CHALLENGER took specimens of *Chaetaster* at her Station 36, off Bermuda, 30 fms., but Sladen (1889, CHALLENGER Asteroidea, p. 399) regarded them as examples of the Mediterranean species, *longipes*, although he says "a number of the examples" from Bermuda have here and there tubercular enlargements of the paxillae" like those characteristic of *nodosus*. Unfortunately he gives no information as to the number, size or form of these specimens from the Challenger Bank, data which would now be of very great value. Verrill (*l. c.*) suggests that these specimens taken by the CHALLENGER are probably *nodosus* and not *longipes*. Examination of the six specimens in the Museum of Comparative Zoölogy collection, all from the Challenger Bank, shows positively that they are not *longipes* and Sladen was no doubt in error in referring his Bermudan material to that species. For *longipes* has well-marked series of actinal intermediate plates extending far out on the arm, and even in a specimen with R only 24 mm., one of these series is evident. These inter-

mediate plates are wanting in *nodosus*, except on the actinal surface of the disk, where there are a few; the lower surface of the arm is covered chiefly by the inferomarginal plates, which abut directly on the adambulacral plates. The Bermudan specimens agree with *nodosus* in this, and should, I think, be referred to that species, but it must be admitted that they differ from both Perrier's description, and Verrill's description and figures, of *nodosus* in their much smaller size and longer and more slender rays. Perrier's type, from Guadeloupe, had $R = 70$ mm., while the specimens Verrill studied had $R = 74$ and 76 mm. Sladen gives no measurements of his specimens from Bermuda, but the largest of the six Museum specimens from the Challenger Bank has R only 40 mm. These specimens have the ray only about a third as wide at tips as at base, while in the West Indian specimens it seems to be as much as two-fifths. Verrill's figures show this, although his description says the rays taper "to unusually slender tips." Perrier, on the other hand, says the rays "terminés en pointe très-obtus." Whether this difference in the form is constant and has any significance can only be determined by actual comparison of specimens of the same size.

Sladen implies, but does not directly say, that some of the CHALLENGER specimens lacked the "tubercular enlargements" characteristic of *nodosus*. Of the specimens in the Museum of Comparative Zoölogy collection, the three which are dried show these enlargements plainly; in the smallest $R = 34$ mm.), there are 9, in the largest ($R = 40$ mm.), about 25, and in the third specimen ($R = 36$ mm.), about 35. The enlarged plates are all either abactinal or rarely superomarginal, and are chiefly on the basal half of the rays; they are only rarely on the disk. They vary greatly in size and grade down to normal plates. In the alcoholic specimens, they are much less conspicuous than in the dried ones, although the specimens are of about the same size, and in one individual they seem to be quite wanting. It seems probable that both in number and size the enlarged plates increase with the age of the individual.

***Ophidiaster schismochilus*² sp. nov.**

Plate I.

$R = 113$ mm.; $r = 11$ mm.; $br = 16$ mm.; $R = 10r$ or $7br$.
Disk very small and flat. Rays very unequal (113, 100, 90, 85, 55,

² σχίσμα, a cleft + χῆλος, a lip or margin, in reference to the numerous pedicellarian clefts on the margin of the ambulacral furrows.

mm.), but only the two longest have normal tips; the next two have the tips truncate and the shortest has the tip conspicuously regenerated, the new part being 7 mm. long; all the rays are flattened cylindrical, slightly constricted at base; only the terminal fourth tapers to the normally pointed tip. Body surface very finely and uniformly granular, 80 or more granules to a square millimeter in the dry condition. Papulae in 8 well-marked series of large, scarcely depressed areas, 20-50 to each area, except near base and tip of arm, and on disk, where areas are evidently smaller; papulae of actinal areas appear to be a little larger than those of abactinal surface; on basal part of arm each area is very much larger than any adjoining plates, a typical one being 2 mm. long and 4 mm. wide; series of areas fairly regular and parallel till very near arm-tip where they converge and each area is greatly reduced containing only one or two papulae. Marginal plates not noticeably larger than, nor different from, abactinal plates. Terminal plate relatively small, not much more than 2 mm. across, not granular but with about 7 fairly large tubercles. Madreporite smooth, flat, 3 mm. across.

Pedicellariae numerous but widely scattered abactinally, not on the plates but on the papular areas with seldom more than one to an area; the valves and sockets are straight and narrow; each valve is about 0.3-0.4 mm. long, markedly compressed, straight, terminating in a sharp tooth nearly at a right angle to the valve itself; below this terminal tooth are three or four much smaller and stouter, blunter teeth; the sides of the socket are somewhat irregularly serrate in the dry condition but carry no real teeth. Actinally there are several pedicellariae on the interradial areas and here and there on a papular area on the rays, but the characteristic feature of the species is the series of pedicellariae that lie on the adambulacral plates between the furrow spines and the subambulacral spines; these pedicellariae are somewhat larger than those of the abactinal surface but are otherwise like them; for the most part they lie end to end in a single almost continuous series placed on a fleshy ridge or fold of skin close to the subambulacral spines, but there are many scattered pedicellariae also, usually lying at more or less of an angle to the ridge or squarely across it, and in many places the ridge disappears or is very indistinct; there is no ridge and there are few pedicellariae on the distal third of the ray.

Adambulacral armature as usual in two series; furrow spines in pairs, subequal, about three or four times as long as wide and about once and a half as wide as thick, with slightly rounded tips, con-

nected together by a thin membrane without granules on either surface. Subambulacral spines conspicuous, stout, slightly flattened, with blunt tips, about 2 mm. long and not quite a millimeter thick; there are half a dozen subambulacral spines on the first half dozen adambulacral plates, but further out there is only one such spine to each pair of adambulacral plates, or occasionally the ratio is one to three. Oral plates concealed; oral angles with half a dozen marginal spines on each side, and several pedicellariae and two stout suboral spines (one on each plate) on the surface. Color light yellowish-brown without any markings. The specimen is now without any trace of the color the sea-star had in life.

Holotype, M. C. Z. No. 2758. Bermuda: Challenger Bank, $30\frac{1}{2}$ fms. Aug. 1, 1903.

This is one of the most clearly marked members of the genus, not at all like the other West Indian species. The small skeletal plates and unusually large papular areas give it a characteristic facies, while the size, form and arrangement of the pedicellariae are also very distinctive. As no species of *Ophidiaster* has been found north of southern Florida, not even in the Bahamas, the occurrence of this fine new form on the Challenger Bank is of exceptional interest.

***Stephanasterias gracilis*.**

Asterias gracilis Perrier, 1881. Bull. M. C. Z., 9, p. 4.

Stephanasterias gracilis Verrill, 1899. Trans. Conn. Acad., 10, p. 223; 1915, Bull. Univ. Iowa: Nat. Hist., 7, p. 25; pl. IX, figs. 2-2e.

This is a very small sea-star, the largest specimen of the more than sixty in the M. C. Z. having R only 20 mm. and the great majority of the specimens are much smaller than that. It has been recorded from numerous stations in the West Indian region in from 56 to 270 fms., but it has never been reported from so far north as the Bermudas nor from such shallow water as that which covers the Challenger Bank. There are four specimens, however, in the collection made by the party of 1903, and the depth at which they were taken is recorded as $30\frac{1}{2}$ fms. They are all very small and as usual in the species, they show great diversity in form. The largest has three arms with R = 9 mm. while the three on the other half of the body has R = 5-6 mm. A second specimen has the arms 9, 8, 7, 5, 4 and 4 mm. long, the three longest opposite the three shortest. A third specimen has three arms about 7 mm. long and on the other side, three about $1\frac{1}{2}$ mm. The smallest specimen has but three arms,

each about 5 mm. long, and there is no evidence as yet of new arms forming. Of course, these peculiarities are due to the autotomous asexual reproduction, characteristic of the genus. There is no clue to what the color in life may have been.

Stolasterias tenuispina.

Asterias tenuispina Lamarek, 1816. Anim. s. Vert., 2, p. 561.

Asterias (Stolasterias) tenuispina Sladen, 1889. CHALLENGER Asteroidea, pp. 563, 583.

This species has long been known from Bermuda, where it is decidedly the most common sea-star, so its occurrence on the Challenger Bank is not surprising. It is worthy of note, however, that the specimens collected in 1903 are all very small, the largest of the five being only 13 mm. across its six arms. One has seven arms, while the smallest, which is obviously the result of a recent autotomous division, has but three.

Coronaster briareus.

Asterias briareus Verrill, 1882. Amer. Jour. Sci., 23, p. 220.

Coronaster briareus Verrill, 1914. Monograph of the Shallow-water Starfishes of the North Pacific Coast, p. 49.

The occurrence of this rare sea-star on the Challenger Bank is not surprising, as it has previously been recorded both north and south of that latitude and has been taken at least once in quite a shallow water. Nevertheless the specimen in the present collection is notable, for it is not only of unusually large size but it has an extraordinarily large number of arms. There are six arms on one side of the disk, 110–125 mm. long, while on the other side are two sets, one of five and one of four arms, 10–16 mm. long. The inner two arms of the set of five lie somewhat above the inner arms of the set of four, as though one series overlapped the other. Verrill says the "rays" are "variable in number, ten to twelve in the larger specimens; one of the larger has the radii 8 mm. and 76 mm.; ratio 1 : 9.5." (1915, Bull. Univ. Iowa: Nat. Hist., 7, p. 31). In the present 15-rayed individual, the lesser radius is about 8 mm. Since the greater radius is 110–125, the ratio is something like 1 : 13–16, or as it is more usually expressed $R = 13-16r$. The color of the alcoholic specimen is the usual yellowish of bleached material and there is no indication of what the color may have been in life. Perrier's figure of *C. parfaiti* (1894, Trav. et Tal., Stell., pl.

VIII) shows that species to be conspicuously red. Professor Nutting in his Narrative of the Bahama Expedition (1895, Bull. Univ. Iowa: Nat. Hist., 3, p. 168) is enthusiastic over the beauty of the Coronasters collected, but says never a word as to the color!

OPHIUROIDEA: BRITTLE-STARS.

Ophiomyxa flaccida.

Ophiura flaccida Say, 1825. Jour. Acad. Nat. Sci. Philadelphia, 5, p. 151.

Ophiomyxa flaccida Lütken, 1859. Add. ad hist. Oph., pt. 2, p. 79.

This common West Indian brittle-star is well known from several Bermudan stations. It was taken on the Challenger Bank by the CHALLENGER in 32 fms. but was not met with by the party from the Bermuda Biological Station.

Ophiactis savignyi.

Ophiolepis savignyi Müller und Troschel, 1842. Sys. Ast., p. 95.

Ophiactis savignyi Ljungman, 1867. Öfv. Kongl. Vet.-akad., Förh., 23, p. 323.

The occurrence of this ubiquitous tropicopolitan brittle-star at the Challenger Bank is quite natural. Indeed, it would be extraordinary if it did not occur there. Yet its presence is indicated by only a single small specimen taken in 1903.

Ophiothrix angulata.

Ophiura angulata Say, 1825. Jour. Acad. Nat. Sci. Philadelphia, 5, p. 145.

Ophiothrix angulata Ayres, 1852. Proc. Boston Soc. Nat. Hist., 4, p. 249.

This common West Indian brittle-star, which Verrill (1900, Trans. Conn. Acad., 10, p. 585) lists as "not common" at Bermuda, was taken at the Challenger Bank by both the CHALLENGER party and the one from the Bermuda Station. Lyman says nothing whatever as to the specimens taken by the CHALLENGER, but those taken by the party in 1903 represent two quite distinct varieties:

OPHIOTHRIX ANGULATA VAR. PHOINISSA.

H. L. Clark, 1918. Bull. M. C. Z., 62, p. 317.

A single individual of this form was taken. It is 5 mm. across the disk and the uniformly deep red color is perfectly evident, though

lighter in the dry specimen than it is in life. The variety has previously been reported only from Cuba and the Tortugas.

OPHIOTHRIX ANGULATA VAR. *POECILA*.

H. L. Clark, 1918. Bull. M. C. Z., 62, p. 319.

There are four quite typical examples of this variety, all dry and showing the usual variegated coloration well. A fifth and larger specimen, 6 mm. across the disk, is in alcohol, and has lost all distinctive coloration, but the disk-covering and arm-spines and plates are as in the smaller specimens. As there is no indication of a white longitudinal stripe on the arm, it seems best to consider this specimen also as *poecila*, although it is not at all unlikely that it represents the red-orange form which I have called var. *phlogina* (l. c., p. 318).

Ophiothrix suensonii.

Lütken, 1856. Vid. med., p. 16.

This very handsome and easily recognized species was taken at the Bank by the CHALLENGER and again by the party from the Bermuda Biological Station. The latter secured four specimens, of which the largest is 7 mm. across the disk and has the arms over 50 mm. long. Verrill (1900, Trans. Conn. Acad., 10, p. 585) reports that this species was taken by G. Brown Goode at Bermuda, but it is more than likely that the specimen secured by Goode was from "off shore." For neither Verrill himself, nor the New York University parties, nor the Bermuda Biological Station collectors (and they have been many!) nor myself, have ever found *suensonii* at Bermuda.

Ophiocoma pumila.

Lütken, 1859. Add. ad Hist. Oph., pt. 2, p. 141.

A single very small 6-rayed specimen with disk about 4 mm. across was taken in 1903. As the species is very common at Bermuda, it would be strange indeed if it did not occur on Challenger Bank.

Ophiocoma riisei.

Lütken, 1859. Add. ad Hist. Oph., pt. 2, p. 141.

This species is also common at Bermuda and hence its occurrence at Challenger Bank would be expected. But the only specimen as

yet known from there is a very young one (disk about 3.5 mm. across) taken by the 1903 expedition. The contrast in appearance between this specimen and the young *pumila* just listed is very striking and one finds it hard to consider them congeneric. For in *pumila* the arms are rather short and stout with short, basally thickened arm-spines and the disk has its scales pretty completely concealed under the covering of elongated granules; whereas in *riisei*, the arms are long and slender, with long, slender arm-spines, and the disk carries no granules but is covered by a well-marked coat of scales. In both cases, however, one is strongly reminded of the Ophiacanthidae and it is only from the presence of evident dental papillae, and the character of the tentacle-scale, that the relationship to the Ophiocomidae can be deduced.

ECHINOIDEA: SEA-URCHINS.

Stylocidaris affinis.

Cidaris affinis Philippi, 1845. Arch. Naturg., Jhg. 11, 1, p. 351.
Stylocidaris affinis Mortensen, 1909. Ech. Deutsch. Südpolar-Exp., p. 52.

The occurrence of this cidarid at Challenger Bank is of great interest as it extends the known range of the species very considerably to the northeast, so far at least as the western side of the Atlantic is concerned. As *affinis* occurs in the Mediterranean, and probably at the Cape Verde Islands, its occurrence near Bermuda helps to bridge the gap between the West Indian and European areas. The specimen taken by the party in 1903 is only 10 mm. in diameter and has the primary spines only about 15 mm. long, but its identity seems to be beyond question.

Centrechinus antillarum.

Cidaris (Diadema) antillarum Philippi, 1845. Arch. Naturg., Jhg. 11, 1, p. 355.
Centrechinus antillarum H. L. Clark, 1918. Bull. Lab. Nat. Hist. Iowa, 7, no. 5, p. 24.

Two very young individuals were taken in 1903. They are about 8 mm. in diameter with primary spines about 16 mm. long. The general color is quite different in the two, one having the primaries light claret red, rather indistinctly banded with whitish, while the other has them whitish distinctly banded with pale brown.

EXPLANATION OF PLATE I.

- FIGURE 1. View of actinal surface of *Ophidiaster schismochilus* sp. nov. Holotype. Natural size.
- FIGURE 2. View of abactinal surface of the same specimen. Natural size.

